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(54) **AUGMENTATION OF ELEMENTS IN A DATA CONTENT**

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US 2016/0155272 A1 Jun. 2, 2016

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G06T 19/00	(2011.01)
G06F 3/041	(2006.01)

(52) **U.S. Cl.**
CPC ***G06T 19/006*** (2013.01); ***G06F 3/041*** (2013.01)

(58) **Field of Classification Search**
CPC . G06T 19/006; G06T 19/00; G06K 9/00671; G06K 9/46
USPC 382/103
See application file for complete search history.

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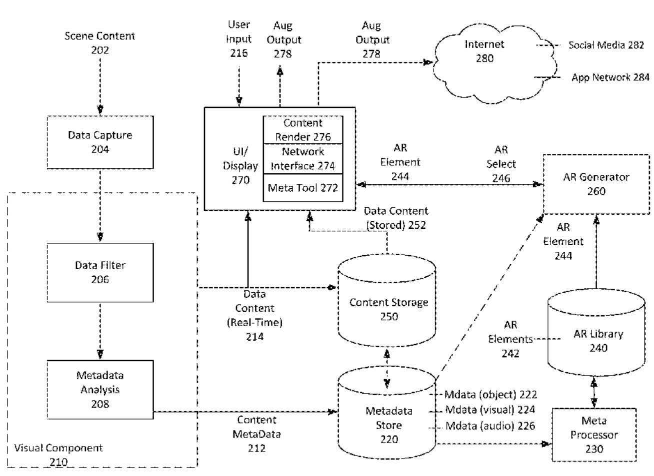
(57) **ABSTRACT**

A computing device can augment video content by receiving video content from an image capturing device and detecting and tracking a self-propelled device in the video content. The computing device can display a plurality of augmented reality elements selectable to augment the self-propelled device and receive a user selection of one of the plurality of augmented reality elements to augment the self-propelled device. The computing device may then augment the self-propelled device in the video content by superimposing the selected augmented reality element over the self-propelled device as the self-propelled device moves.

20 Claims, 4 Drawing Sheets



Related U.S. Application Data

a continuation-in-part of application No. 14/054,636, filed on Oct. 15, 2013.

(60) Provisional application No. 61/646,716, filed on May 14, 2012.

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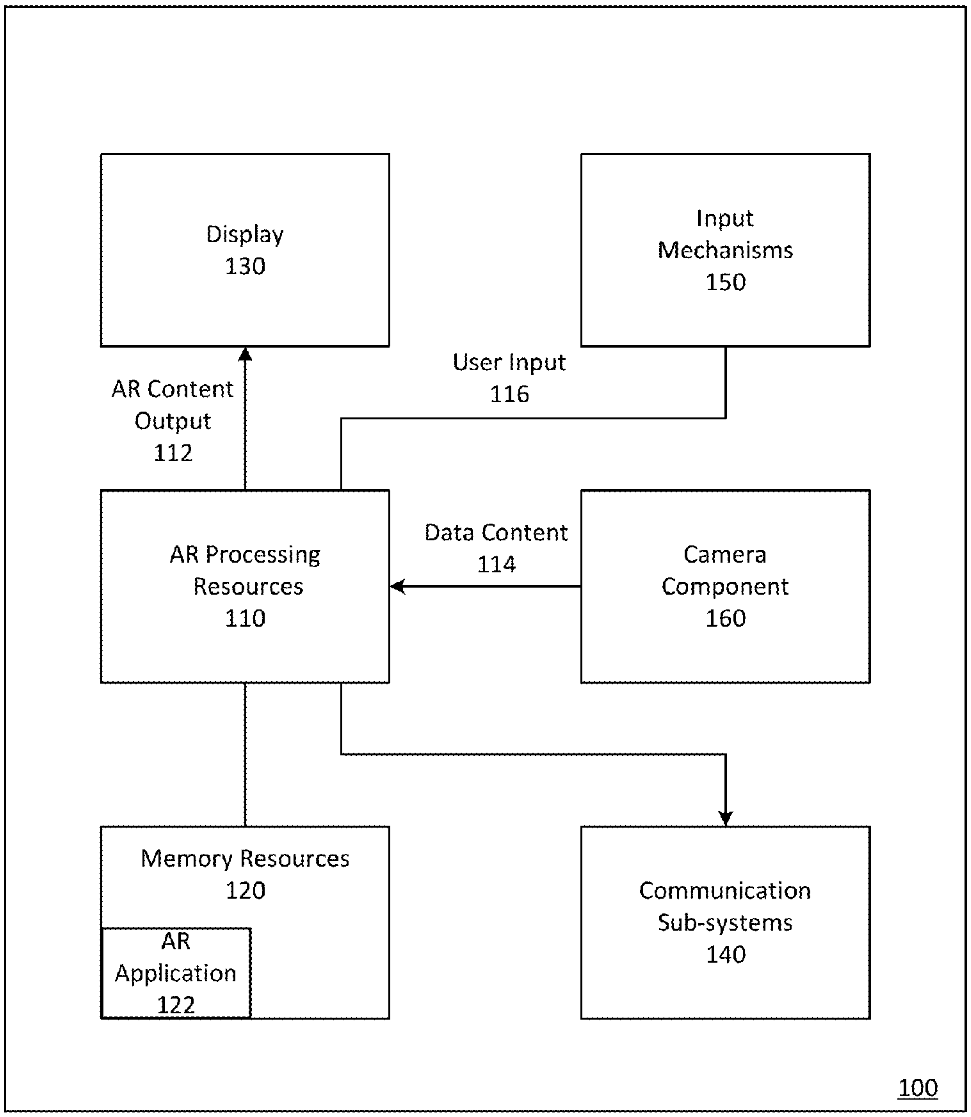
Display
130
Input
Mechanisms
150
User Input
116
AR Content
Output
112
AR Processing
Resources
110
Data Content
114
Camera
Component
160
Memory Resources
120
AR
Application
122
Communication
Sub-systems
140
100

FIG. 1

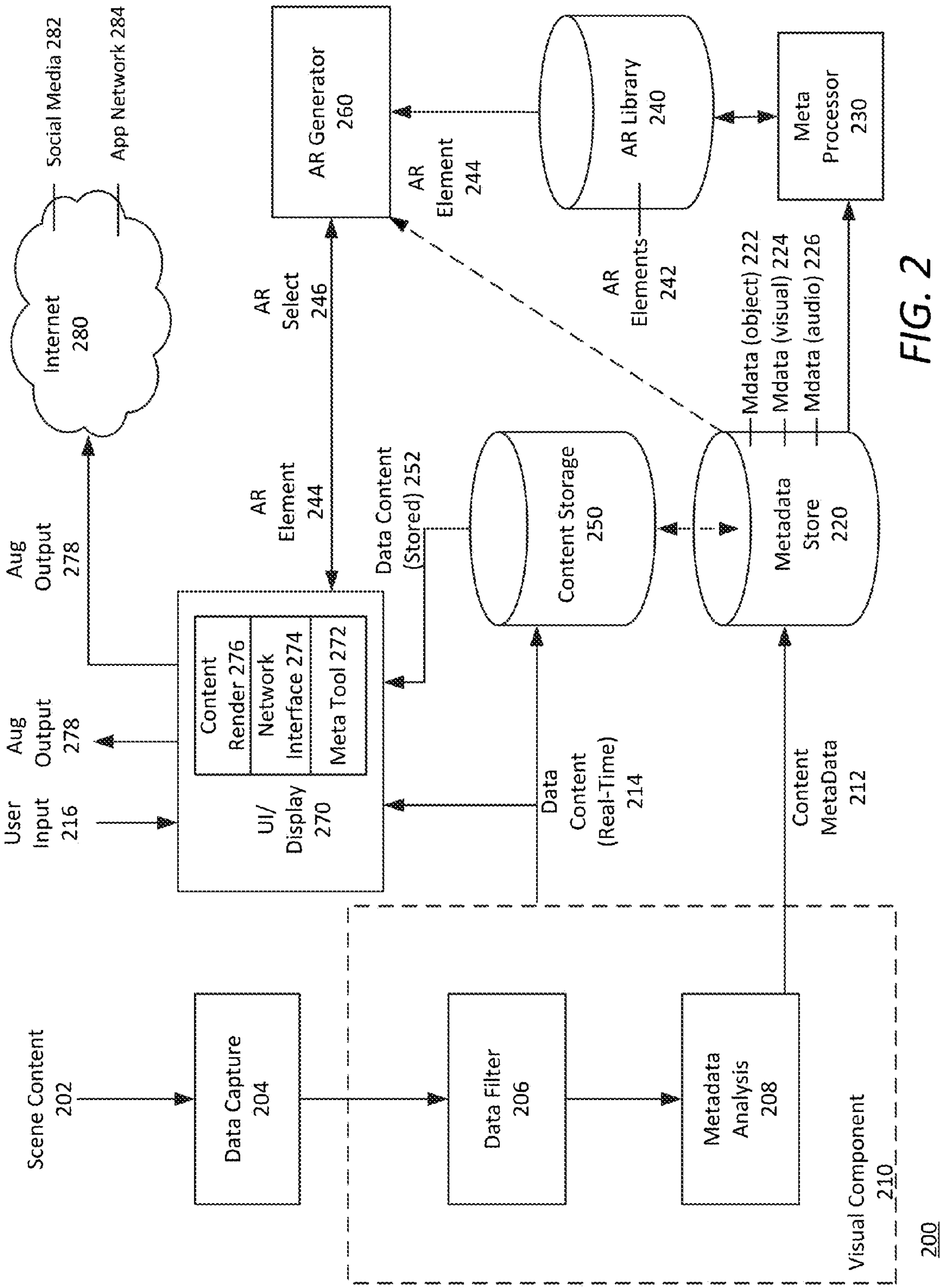
Scene Content 202
Data Capture 204
Data Filter 206
Metadata Analysis 208
Visual Component 210
200
User Input 216
Aug Output 278
Aug Output 278
Content Render 276
Network Interface 274
Meta Tool 272
UI/ Display 270
Data Content (Real-Time) 214
Content MetaData 212
Internet 280
Social Media 282
App Network 284
AR Element 244
AR Select 246
Data Content (Stored) 252
Content Storage 250
Metadata Store 220
Mdata (object) 222
Mdata (visual) 224
Mdata (audio) 226
AR Generator 260
AR Element 244
AR Library 240
AR Elements 242
Meta Processor 230

FIG. 2

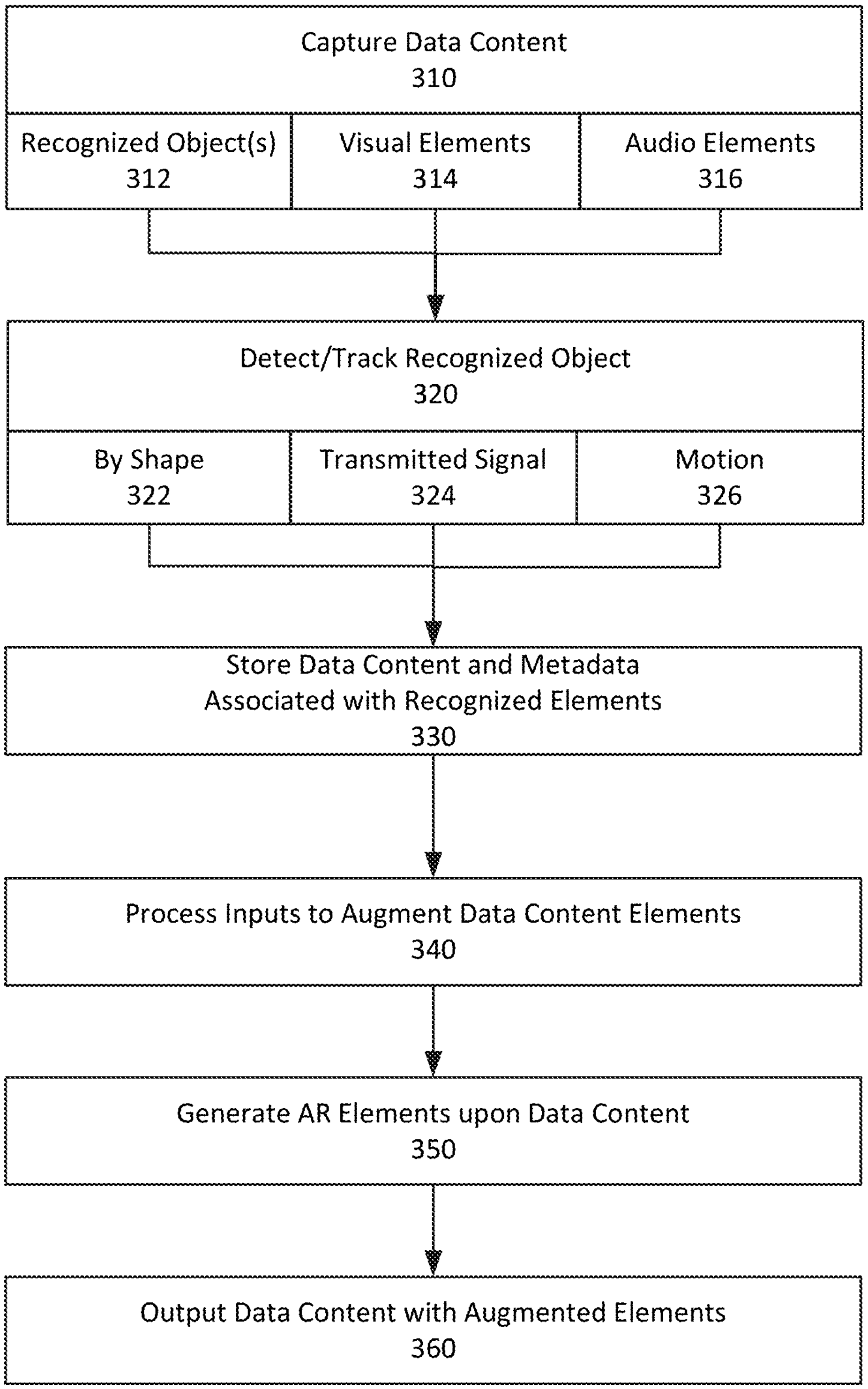
Capture Data Content
310
Recognized Object(s)
312
Visual Elements
314
Audio Elements
316
Detect/Track Recognized Object
320
By Shape
322
Transmitted Signal
324
Motion
326
Store Data Content and Metadata
Associated with Recognized Elements
330
Process Inputs to Augment Data Content Elements
340
Generate AR Elements upon Data Content
350
Output Data Content with Augmented Elements
360

FIG. 3

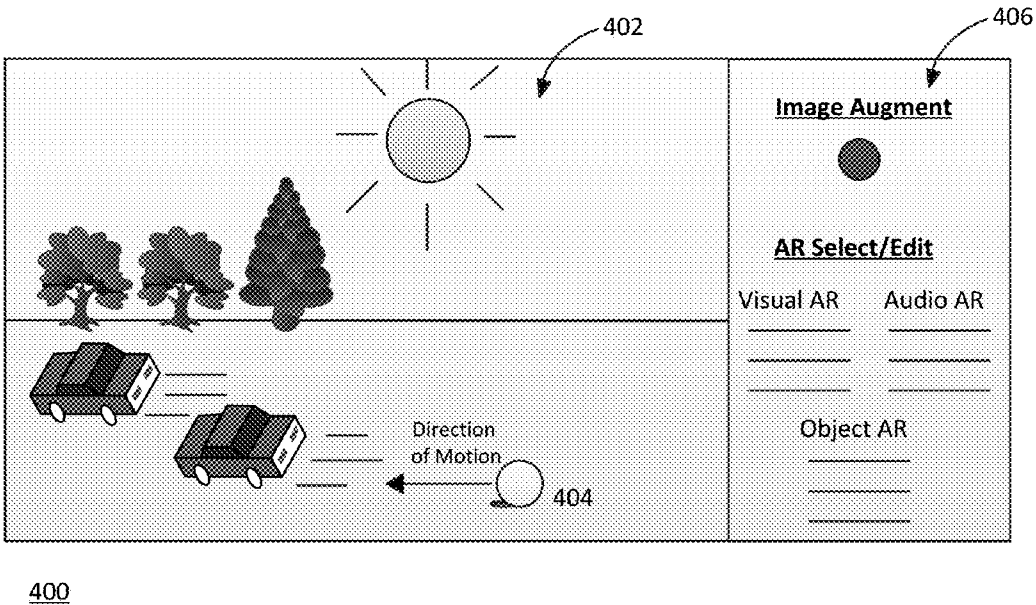
402
406
Image Augment
AR Select/Edit
Visual AR
Audio AR
Object AR
Direction
of Motion
404
400

FIG. 4A

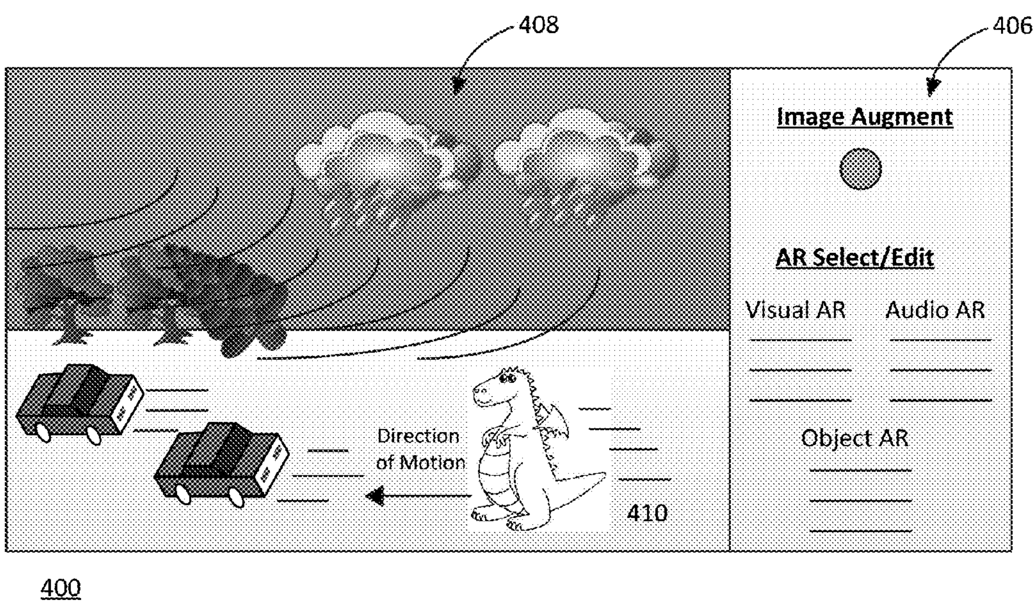
408
406
Image Augment
AR Select/Edit
Visual AR
Audio AR
Object AR
Direction
of Motion
410
400

FIG. 4B

AUGMENTATION OF ELEMENTS IN A DATA CONTENT

RELATED APPLICATION

This application is a continuation application of U.S. application Ser. No. 14/148,541, filed Jan. 6, 2014, entitled "AUGMENTATION OF ELEMENTS IN DATA CONTENT," which is a continuation-in-part of U.S. application Ser. No. 14/054,636, filed Oct. 15, 2013, entitled "INTERACTIVE AUGMENTED REALITY USING A SELF-PROPELLED DEVICE," which is a continuation-in-part of U.S. application Ser. No. 13/894,247, filed May 14, 2013, entitled "OPERATING A COMPUTING DEVICE BY DETECTING ROUNDED OBJECTS IN AN IMAGE", which claims priority to U.S. Provisional Patent Application Ser. No. 61/646,716, filed May 14, 2012, entitled "OPERATING A COMPUTING DEVICE BY DETECTING ROUNDED OBJECTS IN AN IMAGE"; the aforementioned applications being hereby incorporated by reference in their respective entireties.

BACKGROUND

Augmented reality implements computer technology to optically enhance, replace, or otherwise change real-word objects in a captured video. Furthermore, computer technology has allowed for various forms of image-based object detection and recognition.

BRIEF DESCRIPTION OF THE DRAWINGS

The disclosure herein is illustrated by way of example, and not by way of limitation, in the figures of the accompanying drawings and in which like reference numerals refer to similar elements, and in which:

FIG. **1** illustrates an example system allowing for data content capture and display;

FIG. **2** illustrates a system and resources to enable real-time and/or post-capture visual/audio augmentation of data content including a recognized object;

FIG. **3** in an example method of enabling augmentation of data content; and

FIGS. **4**A and **4**B illustrate an example of captured data content and a respective example of outputted augmented content.

DETAILED DESCRIPTION

A method of processing data content is disclosed. The method includes receiving data content that includes a captured scene or an observed environment with a recognized object in the scene. The recognized object can be detected and tracked over a duration of the captured data content. Furthermore, the data content is stored, including metadata associated with one or more elements of the data content. These one or more elements can include certain characteristics of the recognized object (e.g., a shape of the object, an audio feature, other visual features, and/or data transmitted from the object).

In variations, user inputs can be processed to augment the one or more elements of the stored data content. In response to processing the inputs, the method includes augmenting the data content by introducing one or more augmented elements into the data content based on the user inputs. These one or more augmented elements can correspond to respective one or more elements of the stored data content. Furthermore, the augmented data content can then be outputted on a display of the user's computing device.

Further still, the method can include enabling real-time virtual augmentation of the one or more elements of the data content. In such, variations, the augmented content can be outputted in real time, and include the augmented elements. The outputted augmented data can include augmented visual, audio, and/or virtual representations of the recognized object. Accordingly, a set of virtual characters or representations may be provided to the user for selection to represent the recognized object in real time. The recognized object can further output data corresponding to specific characteristics of the recognized object. The outputted data can be associated with metadata corresponding to the characteristics of the recognized object.

A computing device may be provided to implement the method, and execute logic to detect and one or more objects in an observed environment. The computing device implements a graphic user interface to enable a user to augment the data content, including the detected objects, in real-time. Furthermore, the captured data content can be stored and various elements of the data content can be augmented and/or edited post-capture by the user.

Augmentation of the data content can be performed programmatically via user input by overwriting metadata captured, created, and/or stored during capture of the data content. For example, metadata associated with the tracked object, audio data, and various visual elements of the data content is stored and associated with various augmented reality elements that can ultimately be utilized by a user to produce augmented data content based on the captured data content.

One or more images, including frames of real-time video and/or other data content, are received from an capturing component of the computing device. The computing device can operate one or more applications or operate in one or more modes that use the components of the capturing component in order to receive the data content. The data content can be of a scene and/or objects in the scene in which the lens of the capturing component is focused or pointed towards. For example, the scene can include an object of interest that is in motion.

The computing device receives data content as a plurality of images in order to detect and track one or more recognizable objects (corresponding to one or more objects of interest) in one or more of the images. A recognizable object that depicted in an image, for example, can correspond to an object having at least a housing or structure with a rounded shape or a partial rounded shape, such as an ellipse, oval, disc, sphere, etc. The one or more recognizable objects can correspond to, for example, a ball, a circular object, a cylindrical object, a ready-recognizable household object, a self-propelled device having a particularly recognizable housing, an object of nature, a man-made structure or vehicle, etc., that is included within the scene (e.g., data content detected by the capturing component). In some examples, a self-propelled device can be modified (e.g., post assembly) to include a rounded, spherical, or cylindrical aspect (e.g., attach a rounded object to the self-propelled device or drop a ping pong ball in a truck bed of a remote controlled truck). The computing device can process and utilize the recognized objects in the images as inputs for performing one or more operations or processes on the computing device, such as for visual augmentation or enhancement.

Received images of the captured data content can be individually processed in order to detect the one or more objects. The computing device can use one or more detection techniques, together or individually, in order to detect the object(s). These detection techniques can include using an image filter and/or a detection algorithm based on a size or shape of the object. In addition, the detection techniques can be used to determine position information for one or more of the recognized objects based on a relative position of object(s) in the one or more images. Detecting the object(s) in the images can also enable the computing device to track the movement of the object(s), as well as a velocity and/or acceleration.

Upon detecting one or more recognizable objects in the received images, the computing device can utilize the detected objects and the respective position information as inputs for performing additional operations or processes. For example, the computing device can adjust or augment the images that include the detected objects in real time, and present the adjusted images on a display of the computing device. In such examples, a user of the computing device may be presented a user interface for augmenting one or more of the detected objects, including superposition of virtual characters and altering aspects of sound and/or visual characteristics of the captured data content.

The capturing component can be distinct and separate from the computing device that detects the one or more objects in the captured data content. The capturing component and the computing device can wirelessly communicate with each other in order to enable the computing device to receive the one or more images from the capturing component. A recording device, such as a video capturing device, can also be separate from and wirelessly communicate with the computing device. In other embodiments, the devices can be a part of or be incorporated together as one device.

Embodiments described herein also provide for the operations and/or processes that are performed by the recording device and/or the capturing component and/or the computing device to be performed at different times and different orders (e.g., shifted temporally).

One or more embodiments described herein provide that methods, techniques, and actions performed by a computing device are performed programmatically, or as a computer-implemented method. Programmatically, as used herein, means through the use of code or computer-executable instructions. These instructions can be stored in one or more memory resources of the computing device. A programmatically performed step may or may not be automatic.

One or more embodiments described herein can be implemented using programmatic modules or components of a system. A programmatic module or component can include a program, a sub-routine, a portion of a program, or a software component or a hardware component capable of performing one or more stated tasks or functions. As used herein, a module or component can exist on a hardware component independently of other modules or components. Alternatively, a module or component can be a shared element or process of other modules, programs or machines.

Some embodiments described herein can generally require the use of computing devices, including processing and memory resources. For example, one or more embodiments described herein may be implemented, in whole or in part, on computing devices such as digital cameras, digital camcorders, desktop computers, cellular or smart phones, personal digital assistants (PDAs), laptop computers, printers, digital picture frames, and tablet devices. Memory, processing, and network resources may all be used in connection with the establishment, use, or performance of any embodiment described herein (including with the performance of any method or with the implementation of any system).

Furthermore, one or more embodiments described herein may be implemented through the use of instructions that are executable by one or more processors. These instructions may be carried on a computer-readable medium non-transitory in nature. Machines shown or described with figures below provide examples of processing resources and computer-readable mediums on which instructions for implementing embodiments can be carried and/or executed. In particular, the numerous machines shown with embodiments include processor(s) and various forms of memory for holding data and instructions. Examples of computer-readable mediums include permanent memory storage devices, such as hard drives on personal computers or servers. Other examples of computer storage mediums include portable storage units, such as CD or DVD units, flash memory (such as carried on smart phones, multifunctional devices or tablets), and magnetic memory. Computers, terminals, network enabled devices (e.g., mobile devices, such as cell phones) are all examples of machines and devices that utilize processors, memory, and instructions stored on computer-readable mediums. Additionally, embodiments may be implemented in the form of computer-programs, or a computer usable carrier medium capable of carrying such a program.

Hardware Diagram

FIG. **1** illustrates an example hardware diagram of a computer system upon which examples described herein can be implemented. A computing device **100** corresponds to a mobile computing device, such as a cellular device that is capable of telephony, messaging, and data services. Examples of such devices include smart phones, handsets or tablet devices for cellular carriers, digital cameras, or laptops and desktops (e.g., PC). Computing device **100** includes processing resources (e.g., one or more processors for augmenting data content) **110**, memory resources **120**, a display **130**, one or more communication sub-systems **140** (including wireless communication sub-systems), input mechanisms **150**, and camera components **160**. The display **130** can be a touch-sensitive display that can also receive input from a user. One or more of the communication sub-systems **140** can send and receive cellular data over data channels and voice channels.

The augmented reality (AR) processing resources **110** can be configured with software and/or other logic to perform one or more processes, steps, and other functions described below. The processing resources **110** can be configured, with instructions and data stored in the memory resources **120**, to implement the system **100**. For example, instructions for implementing object detection, augmentation logic, metadata overwrite, a graphic user interface, and device control can be stored in the memory resources **120** of the computing device **100**.

Additionally or as an alternative, the processing resources **110** are configured to execute instructions for operating object detection and for receiving images or data content **114** that have been captured by the lens and/or other components **160** of the capturing component. After detecting one or more objects or elements in one or more images, the processing resources **110** can execute instructions for causing AR content output **112** to be presented on the display **130**. Such AR content output **112** can be augmented according to user inputs **116** and adjustments in real-time or during post-processing or post-capture of the data content **114**. The processing resources **110** can also execute instructions based on the user inputs **116** from a remote device via the communication sub-systems **140**.

The processing resources **110** can be configured to execute and operate a variety of different applications and/or functionalities, such as, for example, a home page or start screen, an application launcher page, messaging applications (e.g., SMS messaging application, e-mail application, IM application), a phone application, game applications, calendar application, document application, web browser application, clock application, camera application, media viewing application (e.g., for videos, images, audio), social media applications, financial applications, and device settings.

For example, an executed application (e.g., AR application **122**) on the computing device **100** can be specific to remotely controlling a self-propelled device, which can correspond to the recognized object in the data content **114**. The AR application **122** can enable the user of the computing device **100** to augment the data content **114** in real-time and/or record the data content including the self-propelled device for storage and future editing. The same application **122**, or a separate application specific to augmenting data content, can be executed to enable the user to edit the data content **114**, including augmenting one or more elements of the data content **114**, as described in detail below.

System Description

FIG. **2** illustrates a system and resources to enable real-time and/or post-capture visual/audio augmentation of data content including a recognized object. Various features described with respect to FIG. **2** can be implemented and/or utilized via the computing device **100** of FIG. **1**. Furthermore, components and features described with respect to FIG. **2** can be configured for execution in conjunction with or as an alternative to features of FIG. **1**. For example, the visual component **210** of FIG. **2** is integrated within the computing device **100** of FIG. **1**, or alternatively, outsourced as a separate component of, for example, a server or data processing entity. Similarly, the content storage **250** and the data capture component **204** of FIG. **2** can be integrated in the computing device **100** of FIG. **1**, or provided as separate components of the system. Along these lines, various components illustrated in FIG. **2** can either be integrated as a part of the computing device **100** as a whole, or provided as external components of the system **200**.

Referring to FIG. **2**, a system **200** is illustrated in which scene content **202** is captured or otherwise delivered to a data capture component **204**. The data capture component **204** can run the scene content **202** through a visual component **210**, which can include a data filter **206** and a metadata analysis component **208**. The data capture component **204** may be a camera provided on a computing device **100**. Alternatively, the data capture component **204** may be part of an interface to an external processing resource provided in the system **200**.

The visual component **210** can have an input corresponding to the scene content **202** captured by or delivered through the data capture component **204**. Furthermore, the visual component **210** can output data content **214** corresponding to real-time displayed content or captured data content for storage in a content storage **250**. Additionally, the visual component **210** can include a data filter **206** and a metadata analysis component **208** to parse the scene content **202** into recognized objects or elements and create and/or organize metadata associated with those recognized objects or elements. Thus, another output of the visual component

210 is content metadata **212** associated with the recognized objects or elements in the scene content **202**.

The data filter **206** can implement an algorithm configured to distinguish and recognize one or more elements of the scene content **202** in order to produce filtered content. For example, the processed algorithm can be configured to recognize one or more certain objects in the scene content **202**, such as rounded or cylindrical objects, moving objects, natural features, and/or structural features. Additionally, the data filter **206** can work in conjunction with the metadata analysis component **208** to associate such recognized objects with metadata and/or automatically write metadata corresponding to features of the recognized objects. Such features may include, for example, a path of a moving object, a luminosity of one or more portions or objects of the scene content **202**, a spatial and/or temporal arrangement of the one or more recognized objects relative to other objects in the scene content **202**, and/or an audio feature over at least a portion of the scene content **202**. Thus, metadata of the scene content **204** can correspond to these various aspects and characteristics which, herein, may be collectively or individually referred to as "elements" of the scene content and/or data content.

The metadata analysis component **208** receives an output from the data filter **206**, which is comprised of the filtered scene content. The filtered scene content includes parsed or segregated elements recognized by the data filter **206** for metadata analysis and/or writing. The metadata analysis component **208** then provides metadata for each recognized element, or each aspect of such, and then output this content metadata **212** to a metadata store **220**. As discussed above, such content metadata **212** can describe (i) a recognized element or characteristic of the recognized object, such as a defined path of the recognized object in motion (**222**), (ii) define a luminosity or other visual characteristic of one or more visual elements or objects of the scene content **202** (**224**), (iii) designate a spatial and/or temporal arrangement of the one or more recognized objects relative to other objects in the scene content **202**, and/or (iv) tag an audio feature over at least a portion of the scene content **202** (**226**).

As an addition or alternative, a recognized object in the scene content **202** can output data that can be sensed or otherwise inputted into the data capture component **204**. In such variations, the recognized object can correspond to a remotely operated device including various sensors and a wireless communication port to transmit characteristics of the device to the user's computing device. These characteristics may include one or more of the device's location, orientation, velocity and/or acceleration, heading, temperature, power level, error features, and the like. Furthermore, these characteristics can be associated with metadata created by the metadata analysis component **208**. These characteristics can further be associated with customized or standard augmented reality (AR) elements **242** stored in an AR library **240** to be ultimately utilized for outputting augmented content **278**.

The metadata store **220** can be included as a memory resource on the computing device **100**. Alternatively, the metadata store **220** can be an external server that associates content metadata **212** with individual associated data content stored in the content storage **250**. For example, a user may have an account with an external source associated with an application executable on the user's computing device **100**. The external source may associate and/or tag content metadata **212** corresponding to specified data content **214** or a specific visual and/or audio recording from the user and stored in the content storage **250**. Furthermore, the content metadata **212** for specified data content **214** can be synchronized to the data content **214** such that post-processing of the content metadata **212** can temporally correlate to the specified data content **214**.

In variations of the system **200**, content storage **250** and metadata storage **220** can comprise the same memory resource. In such variations, the data content **214** and the content metadata **212** can be kept separate via a variety of conventional methods. Alternatively, the data content **214** and the content metadata **212** may not be parsed by the visual component **210** until after the data content **214** is stored and the user executes a program or application to edit and/or augment one or more elements of the data content **214**. As such, the visual component **210** can have an input from the memory resources storing the data content **214**. Furthermore, an application resource, such as a metadata processor **230** or augmented reality (AR) generator **260**, can be provided to parse data content **214**/content metadata **212** for augmentation by the user. For example, once the content metadata **212** is extracted from the data content **214**, any number of AR elements **242** can be provided to allow the user to augment the data content **214**.

The system **200** can allow for real-time augmentation of the data content **214**. In such variations, a user interface **270** can be provided on the display of the user's computing device to provide a direct feed of the real-time data content **214** corresponding directly to the scene content **202**. The user interface **270** can include features such as a meta-tool **272**, a network interface **274**, and a content render component **276**. The user can utilize the meta-tool **272** in order to select AR elements **244** for real-time augmentation of the data content **214**. For example, the visual component **210** can be configured to dynamically track a recognized object during the capturing of the scene content **202**. The resulting real-time data content **214** and corresponding content metadata **212** for the scene content **202** provides for dynamic augmentation of the recognized object. In such examples, the user can provide user inputs **216** into the meta-tool **272** in order to activate an AR generator **260** to generate one or more augmented elements to be superimposed or otherwise implemented on the recognized object.

The meta-tool **272** can be provided on the user interface **270** to enable the user to ultimately select, in real-time or post-capture, AR elements **242** to enhance, replace, or otherwise augment real-word objects and elements of the data content **214**. In variations, the meta-tool **272** provides features allowing the user to select from a variety of options for augmentation of the data content **214**. For example, the meta-tool **272** can allow the user to make selections **246** of any number of individual virtual characters to represent the recognized object. These virtual characters may include anything from a simple superimposed reference feature highlighting the recognized object, to an illustrated character or modified photograph that may include features representing or demonstrating any number of characteristics of the recognized object. For example, metadata corresponding to the path and/or velocity of the recognized object can allow for the virtual character to be superimposed over the recognized object, or even multiple recognized objects, throughout a duration of the data content **214**.

Additionally, other features can be provided by the meta-tool **272** to augment the data content **214**. These features may include the addition of visual special effects (e.g., modification of lighting or changing the weather conditions), the addition of a variety of audio elements (e.g., adding a laugh track, music, or sound effects), etc. Thus, each feature can execute the AR generator **260** to provide the desired AR elements **244** for augmentation of the data content **214**. For real-time applications, the real-time data content **214** can be augmented in the above-manner to produce a real-time augmented output **278**, which can be displayed on the user interface **270**, streamed to any number of sites the internet **280** (e.g., social media sites **282**), and/or shared via an application network **284** specific to an executed application on the computing device for augmenting the data content **214**. For the latter, the user interface **270** can provide an application interface feature **274** to share the user-created augmented output **278** over the application network **284**.

Additionally or as an alternative, the system **200** can provide for augmentation of previously captured data content **252** stored in the content storage **250**. In such variations, the user can load the stored data content **252** and use the meta-tool **272** provided on the user interface **270** to augment the stored data content **252** in the manner described above. The user interface **270** can further provide a content render feature **276** to present the augmented output **278** on the display of the computing device. Additionally, the augmented output **278** can be shared on a variety of websites or otherwise uploaded to the internet. Further still, the augmented output **278** can be shared over the application network **284** as described above—where a web application specific to the augmentation of the data content **252** can provide for a feature to do so (e.g., an interactive graphic).

In variations of the system **200**, the metadata store **220** and the AR library **240** can be inextricably linked, such that metadata elements parsed and recognized by the visual component **210** can be immediately associated with AR elements **242** stored in the AR library **240**. In such variations, a metadata processor **230** can be included to perform the associations to provide a selectable list of AR elements **242** for the user to choose from in augmenting the data content **252**. The metadata processor **230** can execute instructions to recognize various types of content metadata **212** associated with the data content **252** such as object **222**, visual **224**, and/or audio **226** metadata to allow for the association of the content metadata **212** with specified AR elements **242**.

Alternatively, the association between various types of content metadata **212** and specified AR elements **242** can be performed by the AR generator **260**. As such, the metadata processor **230** and the AR generator **260**, as shown in FIG. **2**, can be the same component in the system **200**. In such variations, the user can make selections **246** using the meta-tool **272**, which can then cause the AR generator **260** to pull the pertinent AR elements **244** from the AR library **240**. Furthermore, the AR generator **260** can directly associate each element of the content metadata **212** from the data content **252** with an appropriate list of available AR elements **242**, and provide a catalog comprised of lists of available AR elements **242** from which the user can select to produce the augmented output **278**.

One or more components of FIG. **2** can be combined with one or more other components in order to achieve the overall objective of enabling the user to augment data content in real-time or post-capture, and shared such augmented content over the web. Furthermore, one or more components of FIG. **2** can be activated or configured to execute programmatic instructions in response to the execution of an application on the user's computing device specific to augmentation of the data content. Such an application can further be specific to controlling a recognized object, such as a remotely operated self-propelled device. Furthermore, the application can combine features of controlling the self-propelled device, providing AR functions to augment video content including the self-propelled device, and/or sharing the video content or augmented video content over social media or an application network specific to the application.

Methodology

FIG. **3** is an example method of enabling augmentation of data content. Examples and variations of the method in FIG. **3** may be implemented via the system **200** of FIG. **2**, and furthermore, in describing examples and variations of the method illustrated in FIG. **3**, reference may be made to various reference characters associated with components of FIG. **2**. Referring to FIG. **3**, a data capture component **204** can capture or otherwise receive data content (**310**). Such data content can correspond to a scene or an observed environment including one or more recognized objects **312**, and can further include various visual elements **314** and audio elements **316** that can later be augmented by a user.

A visual component **210** can filter and parse the data content and output content metadata **212**. The visual component **210** can further be configured to recognize and track objects and elements in the data content (**320**), the information of which may be included in the content metadata **212**. Such recognized objects can include, for example, a remotely operated self-propelled device with a distinctive shape and/or one or more distinct characteristics. Recognized elements can include various visual and audio elements of the captured content. The visual component **210** can include a metadata analysis component **208** to parse and/or create content metadata **212** associated with the recognized elements of the data content.

As an addition or alternative, the recognized object can correspond to a remotely operated device that includes various sensors and a wireless communication port to transmit, or otherwise send out a beacon containing one or more of the object's characteristics to the user's computing device. Thus, the method can include detecting transmissions **324** from the recognized object, and tracking the object and/or processing metadata of the object accordingly. These transmissions **324** can include characteristics of the object that may include one or more of the recognized object's location, orientation, velocity and/or acceleration, heading, temperature, power level, error features, and the like. Furthermore, these characteristics can be associated with metadata created by the metadata analysis component **208**.

As an additional or alternative, the recognized object can be detected and tracked due to its distinctive shape (**322**). In such variations, the recognized object may be spherical in shape, or may include any distinctive characteristics that distinguish the object from the observed scene. Programming logic may be included to detect such a distinctive shape, and track the object for the duration of the captured data content **214**. Furthermore, the object may be tracked according to its motion (**326**). Such motion may be detected to be erratic or otherwise inconsistent with the observed scene, wherein detection logic may identify and track the object moving in such a manner.

The content metadata **212** can then be stored along with the data content (**330**). As discussed with respect to FIG. **2**, the content metadata **212** and the data content **214** can be stored jointly or separately in one or more storage devices. For example, the data content **214** can be stored in a content storage device **250** that is distinct from a metadata store **220**, which can store all the content metadata associated with the data content **214**. However, the data content **214** and its metadata **212** can also remain associated, at least temporally, via various associative storage means.

A user is enabled to augment various elements of the data content. User inputs corresponding to augmentation of the data content may then be processed (**340**). The user can augment the data content in real-time or after the data content has been stored. In either variation, augmentation features can be provided on a user interface **270** to the user's computing device, allowing the user to select from a variety of AR elements **242** to augment the data content. The AR elements **242** can themselves be filtered according to content metadata **212** associated with the data content. Furthermore, an AR generator **260** can interpret the user's inputs **216** and/or selections **246** to provide pertinent AR elements **244**.

Once the user inputs **216** are processed, the AR selections **246** are made, and the pertinent AR elements **244** are provided, the AR elements can be generated and inputted upon the data content (**350**). As discussed, the AR elements **244** can visually or audibly alter elements of the data content, including recognized objects, visual elements (e.g., a luminosity of at least a portion of the data content, weather conditions, etc.), and audio elements (e.g., inputting sound effects or a music track). Rendering the AR elements **244** upon the data content can be performed automatically in response to receiving the user inputs **216**, or can be performed by way of a content render feature **276** on the user interface **270**. For example, the user can provide various inputs **216** in order to edit and augment the data content, and may wish to preview one or more portions of the augmented content. The content render component **276** can be interactive to allow the user to render or edit one or more AR elements **244** into the data content and preview a portion or the whole of the augmented content.

In variations, the data content can be outputted with the augmented elements included (**360**). Outputting the augmented content can be performed dynamically (i.e., in the case of real-time data content augmentation), or post-capture (i.e., where stored data content may be loaded and augmented using user interface tools). As discussed with respect to FIG. **2**, the outputted augmented content **278** can be displayed directly to the user via the user interface **270** or the display of the user's computing device. Additionally or alternatively, the augmented content **278** can be uploaded or streamed to the internet **280**. In similar variations, the user interface can include a feature that allows the user to share the augmented content **278** over various site-based or web-application-based social media platforms. Similarly, the augmented output **278** can be shared through an application on the user's computing device specific to augmentation of the data content. As discussed, such an application can further be specific to controlling a recognized object in the data content, such as a remotely operated self-propelled device, and further can combine features of controlling the self-propelled device, providing AR functions to augment video content including the self-propelled device, and/or sharing the video content or augmented video content over social media or an application network specific to the application.

FIGS. **4**A and **4**B illustrate an example of captured data content and a respective example of outputted augmented content. The examples illustrated in FIGS. **4**A and **4**B may be performed using various components of the system **200** of FIG. **2** and various features of the method discussed with respect to FIG. **3**. Referring to FIG. **4**A, a scene **402** is captured with various visual elements and include a detectable object **404**, such as a sphere or remotely operated device, and presented on a display **400** of the user's computing device. The elements of the scene **402** include, for example, a characteristic of the sky, the weather (e.g., sunny), a color of one or more portions of the scene, items of nature (e.g., trees), man-made objects (e.g., cars), the ground, the detectable or recognized object **404**, various audio inputs, and the like. The object **404** can be stationary or in motion. For illustrative purposes, in FIG. **4**A, the recognized object is shown with a direction of motion. However, for all intents and purposes, the recognized object can move erratically and/or in any manner with any path throughout the scene. Furthermore, the data capture component **204** capturing the scene **402** captures what amounts to a series of images or a video, which may include audio, of the scene **402**. Still further, the data capture component **204** can also move, and metadata associated with the scene content can nevertheless be recorded and/or created despite the motions and changes of the elements within the scene, and the capturing component **204** itself.

The user's computing device can provide such data content on the display **400** as part of a preview of what is being detected and/or captured by the data capture component **204**. Furthermore, a user interface **406** can be provided that includes various features to enable the user to augment data content of the scene **402**. As such, one or more the various elements of the data content can be augmented to produce a variety of augmented content based on the data content.

An example of such augmented content is shown in FIG. **4**B. As shown in FIG. **4**B various elements of the original data content corresponding to the scene **402** have been augmented to produce the augmented content **408** shown in FIG. **4**B. For example, elements such as the luminosity of the sky, the weather, the orientation of certain recognized objects (e.g., the trees), and the recognized object **404** (e.g., a remotely operated device), have been altered and/or augmented to create and output the augmented content **408**. Of note, the recognized object **404** has been augmented by the user to be represented by the virtual character **410** shown in FIG. **4**B. Since metadata corresponding to the path, velocity, acceleration, and/or other characteristics of the recognized object have been stored and/or processed in real-time, the virtual character **410** can dynamically represent the recognized object throughout the entire duration of the data content. Alternatively, the virtual character **410** representing the recognized object can be configured to change at any time over the duration of the data content. Accordingly, augmentation of one or more elements of the data content shown in the original scene **402** of FIG. **4**A can be performed in real-time.

Alternatively, changing of the virtual character **410** can be performed via a trigger on the user interface **406**, or otherwise be configurable during augmentation of the data content. As such, augmented content **408** can correspond to previously recorded data content corresponding to the scene **402**. The user interface **406** can enable the user to augment any number of elements of the data content (and spend as much time as desired) in order to produce the augmented content **408**. Various characteristics of the recognized object **404** corresponding to sensors that can be included in the object (e.g., the object's location, orientation, velocity and/or acceleration, heading, temperature, power level, error features, etc.) may be enhanced or further represented and/or demonstrated by the virtual character **410**. For example, the element of acceleration corresponding to the motion of the recognized device **404** is shown to be demonstrated by the virtual character **410**. However, any of the above-elements can be demonstrated through color change, illuminating outputs (e.g., blinking, dimming, brightening, etc.), and/or variations in size and/or shape of the virtual character **410**. Furthermore, various sound effects can be inputted by the user to demonstrate or correlate to other elements of the data content.

Each of the images of the data content can be processed to detect the recognized object **404**, and the detected object **404** can be processed as input so that, on the display device of the computing device, the displayed character **410** also moves accordingly. In some variations, the images being rendered can be dynamically adjusted. For example, the graphic image of the virtual character **410** can be dynamically changed to a graphic image of a different virtual character in response to a trigger, such as a user input or the recognized object being moved to a particular location or next to another object of interest.

As an addition or alternative, a computing device, such as shown in FIG. **1**, can detect multiple objects in images and track the positions and/or movements of the multiple objects. In some embodiments, a capturing component and/or the computing device that processes the images to detect one or more recognizable objects can be separate and distinct from a computing device that controls the movement of the recognized object, which may correspond to a spherical self-propelled device. Still further, in one variation, content (e.g., a superimposed virtual character) that is rendered based on the detected and tracked object on a computing device can be dynamically altered based on one or more triggers or inputs provided by another computing device.

For example, multiple users can engage with one another in a gaming environment, where a first user controls the movement of the object of interest using a first computing device, while a second user and a third user track the recognized object and render content on their respective computing devices. A fourth user can use a fourth computing device to control what content is being displayed on the second and third users' devices (e.g., dynamically adjust what graphic image is displayed in place of the detected object). For example, in one implementation, the second user can track the recognized object and view rendered content that is different than content that is rendered on a computing device of the third user (e.g., based on the fourth user controlling what content is to be displayed to individual users). Furthermore, the computing devices can communicate with each other via a wireless communication protocol, such as Bluetooth or Wi-Fi.

CONCLUSION

It is contemplated for embodiments described herein to extend to individual elements and concepts described herein, independently of other concepts, ideas or system, as well as for embodiments to include combinations of elements recited anywhere in this application. Although embodiments are described in detail herein with reference to the accompanying drawings, it is to be understood that this disclosure is not limited to those precise embodiments. As such, many modifications and variations will be apparent to practitioners skilled in this art. Accordingly, it is intended that the scope of the invention be defined by the following claims and their equivalents. Furthermore, it is contemplated that a particular feature described either individually or as part of an embodiment can be combined with other individually described features, or parts of other embodiments, even if the other features and embodiments make no mentioned of the particular feature. Thus, the absence of describing combinations should not preclude the inventor from claiming rights to such combinations.

One or more embodiments described herein provide that methods, techniques and actions performed by a computing device are performed programmatically, or as a computer-implemented method. Programmatically means through the use of code, or computer-executable instructions. A programmatically performed step may or may not be automatic.

One or more embodiments described herein may be implemented using programmatic modules or components. A programmatic module or component may include a program, a subroutine, a portion of a program, or a software component or a hardware component capable of performing one or more stated tasks or functions. As used herein, a module or component can exist on a hardware component independently of other modules or components. Alternatively, a module or component can be a shared element or process of other modules, programs or machines.

Furthermore, one or more embodiments described herein may be implemented through the use of instructions that are executable by one or more processors. These instructions may be carried on a non-transitory computer-readable medium. Machines shown or described with FIGS below provide examples of processing resources and computer-readable mediums on which instructions for implementing embodiments can be carried and/or executed. In particular, the numerous machines shown with embodiments include processor(s) and various forms of memory for holding data and instructions. Examples of computer-readable mediums include permanent memory storage devices, such as hard drives on personal computers or servers. Other examples of computer storage mediums include portable storage units (such as CD or DVD units), flash memory (such as carried on many cell phones and tablets)), and magnetic memory. Computers, terminals, network enabled devices (e.g., mobile devices such as cell phones) are all examples of machines and devices that utilize processors, memory and instructions stored on computer-readable mediums. Additionally, embodiments may be implemented in the form of computer-programs, or a computer usable carrier medium capable of carrying such a program.

Although illustrative embodiments have been described in detail herein with reference to the accompanying drawings, variations to specific embodiments and details are encompassed by this disclosure. It is intended that the scope of the invention is defined by the following claims and their equivalents. Furthermore, it is contemplated that a particular feature described, either individually or as part of an embodiment, can be combined with other individually described features, or parts of other embodiments. Thus, absence of describing combinations should not preclude the inventor(s) from claiming rights to such combinations.

While certain embodiments have been described above, it will be understood that the embodiments described are by way of example only. Accordingly, the disclosure should not be limited based on the described embodiments. Rather, this disclosure should only be limited in light of the claims that follow when taken in conjunction with the above description and accompanying drawings.

What is claimed is:

1. A mobile computing device comprising:

a touch-sensitive display;

one or more processors; and

one or more memory resources storing instructions that, when executed by the one or more processors, cause the mobile computing device to:

receive video content from an image capturing device;

detect and track a self-propelled device in the video content;

display, on the touch-sensitive display, a plurality of augmented reality elements selectable to augment the self-propelled device;

receive a user selection of one of the plurality of augmented reality elements to augment the self-propelled device; and

augment the self-propelled device in the video content by superimposing the selected augmented reality element over the self-propelled device as the self-propelled device moves.

2. The mobile computing device of claim **1**, wherein the executed instructions further cause the mobile computing device to:

receive real-time data from the self-propelled device; and

provide an augmentation tool on the touch-sensitive display to enable a user of the mobile computing device to augment the self-propelled device in real time.

3. The mobile computing device of claim **2**, wherein the real-time data received from the self-propelled device comprises one or more of orientation data, temperature data, or power level data of the self-propelled device.

4. The mobile computing device of claim **3**, wherein the selected augmented reality element for the self-propelled device visually represents the real-time data received from the self-propelled device.

5. The mobile computing device of claim **1**, wherein the executed instructions further cause the mobile computing device to:

store the video content to enable a user of the mobile computing device to augment the stored video content after capture.

6. The mobile computing device of claim **1**, wherein the executed instructions further cause the mobile computing device to:

provide an interface feature on the touch-sensitive display to enable a user of the mobile computing device to share the video content, including the augmented self-propelled device, with a number of other users.

7. The mobile computing device of claim **1**, wherein the executed instructions further cause the mobile computing device to:

identify a plurality of elements in the video content;

generate content metadata corresponding to each of the plurality of elements;

using the content metadata, associate each of the plurality of elements with a number of corresponding augmented reality elements;

provide an augmentation tool on the touch-sensitive display to enable a user to select a respective augmented reality element for each of the plurality of elements; and

augment the video content to include the selected respective augmented element for each of the plurality of elements.

8. A non-transitory computer-readable medium storing instructions that, when executed by one or more processors of a mobile computing device, cause the mobile computing device to:

receive video content from an image capturing device;

detect and track a self-propelled device in the video content;

display, on a touch-sensitive display, a plurality of augmented reality elements selectable to augment the self-propelled device;

receive a user selection of one of the plurality of augmented reality elements to augment the self-propelled device; and augment the self-propelled device in the video content by superimposing the selected augmented reality element over the self-propelled device as the self-propelled device moves.

9. The non-transitory computer-readable medium of claim **8**, wherein the executed instructions further cause the mobile computing device to:

receive real-time data from the self-propelled device; and

provide an augmentation tool on the touch-sensitive display to enable a user of the mobile computing device to augment the self-propelled device in real time.

10. The non-transitory computer-readable medium of claim **9**, wherein the real-time data received from the self-propelled device comprises one or more of orientation data, temperature data, or power level data of the self-propelled device.

11. The non-transitory computer-readable medium of claim **10**, wherein the selected augmented reality element for the self-propelled device visually represents the real-time data received from the self-propelled device.

12. The non-transitory computer-readable medium of claim **8**, wherein the executed instructions further cause the mobile computing device to:

store the video content to enable a user of the mobile computing device to augment the stored video content after capture.

13. The non-transitory computer-readable medium of claim **8**, wherein the executed instructions further cause the mobile computing device to:

provide an interface feature on the touch-sensitive display to enable a user of the mobile computing device to share the video content, including the augmented self-propelled device, with a number of other users.

14. The non-transitory computer-readable medium of claim **8**, wherein the executed instructions further cause the mobile computing device to:

identify a plurality of elements in the video content;

generate content metadata corresponding to each of the plurality of elements;

using the content metadata, associate each of the plurality of elements with a number of corresponding augmented reality elements;

provide an augmentation tool on the touch-sensitive display to enable a user to select a respective augmented reality element for each of the plurality of elements; and

augment the video content to include the selected respective augmented element for each of the plurality of elements.

15. A computer-implemented method of augmenting video content, the method being performed by one or more processors of a mobile computing device and comprising:

receiving video content from an image capturing device;

detecting and tracking a self-propelled device in the video content;

displaying, on a touch-sensitive display, a plurality of augmented reality elements selectable to augment the self-propelled device;

receiving a user selection of one of the plurality of augmented reality elements to augment the self-propelled device; and

augmenting the self-propelled device in the video content by superimposing the selected augmented reality element over the self-propelled device as the self-propelled device moves.

16. The method of claim **15** further comprising:

receiving real-time data from the self-propelled device; and

providing an augmentation tool on the touch-sensitive display to enable a user of the mobile computing device to augment the self-propelled device in real time.

17. The method of claim **16**, wherein the real-time data received from the self-propelled device comprises one or more of orientation data, temperature data, or power level data of the self-propelled device.

18. The method of claim **17**, wherein the selected augmented reality element for the self-propelled device visually represents the real-time data received from the self-propelled device.

19. The method of claim **15**, further comprising:

providing an interface feature on the touch-sensitive display to enable a user of the mobile computing device to share the video content, including the augmented self-propelled device, with a number of other users.

20. The method of claim **15**, further comprising:

identifying a plurality of elements in the video content;

generating content metadata corresponding to each of the plurality of elements;

using the content metadata, associating each of the plurality of elements with a number of corresponding augmented reality elements;

providing an augmentation tool on the touch-sensitive display to enable a user to select a respective augmented reality element for each of the plurality of elements; and

augmenting the video content to include the selected respective augmented element for each of the plurality of elements.

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